JPRS-TND-84-010

30 April 1984

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

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WEST EUROPE

DAILY REPORTS FORMATION OF ALP URANIUM POLICY

Canberra THE AUSTRALIAN in English 2 Apr 84 p 9

[Article by Jane Ford, editor of SCITECH: "ALP's Uranium Policy Takes Shape in the Dark"]

[Text] Behind locked doors work is feverishly underway on a report that will shape the final stand of the Prime Minister, Mr Hawke, on uranium at the ALP's July conference in Canberra.

It is being drawn together from submission, discussion, a wealth of literature, overseas visits and advice from government and university experts, all under the direction of the Prime Minister's advisory body, the Australian Science and Technology Council (ASTEC).

A five-member working party, headed by ASTEC chairman Professor Ralph Slatyer, has been working on the highly politically sensitive report since November.

A special five-member secretariat is toiling long into the night, often seven days a week, to complete the report in time to hand it to the Prime Minister in mid May. The aim is to table it before the autumn session of Parliament rises.

It is much the most important report ever tackled by ASTEC and Professor Slatyer is concerned that it should be seen as objective and unbiased, that all views are canvassed thoroughly and that the final report is as comprehensive and authoritative as possible.

Most importantly it must stand up to the intense scrutiny that it is bound to face once it hits the public arena.

It is inevitable, whatever its findings (which many believe are likely to favor uranium mining) that it will come under heavy criticism. The council is very aware that its future reputation as an unbiased advisory body will depend on the soundness of its argument.

Early on the council was worried that the report would be open to accusation of one-sidedness as many of Australia's anti-uranium groups threatened to boycott the inquiry. Members breathed a sigh of relief when the first submission came in from Greenpeace Australia in December.

The ASTEC secretariat is happy to discuss how it has gone about the inquiry, who it has talked to, the problems and the likely structure of the final report — but its contents are another thing entirely.

Drafts of the 300-page or so report are tightly locked away each night, surrounded by tight security, and so far even

Since then submissions have poured in from the majority of Australia's anti-uranium groups, including the Australian Conservation Foundation, the Coalition for a Nuclear Free Australia, Friends of the Earth and the Movement Against Uranium Mining.

But all question the rationale of the inquiry, maintaining it is biased, too narrow, with unrepresentative members and overall will be just a whitewash for the uranium industry.

There is no doubt that the pro-uranium forces have had the biggest say, providing about two-thirds of the 49 submissions. All of the major mining companies involved in the uranium industry, such as Pancontinental, Energy Resources of Australia and Queensland Mines, have put in submissions along with academics with nuclear research interests and other pro-uranium lobby groups.

A number of individuals, many involved at some stage in the industry, or just concerned citizens, have also put forward their views.

the Prime Minister has not glimpsed them.

The secretariat is quick to stress that what many interpreted as a Freudian slip by

the Minister for Finance, Mr Dawkins, at the National Press Club last week, when he hastily checked the remark that the ASTEC inquiry would confirm the new ALP policy, was definitely not due to any prior knowledge of the report's contents.

The council has used the Ranger Uranium report, particularly the first volume drawn up in 1976, as a starting point for the inquiry and from there set out to investigate its main terms of reference.

These include the effectiveness of present Australian nuclear safeguard agreements, the adequacy of existing waste-disposal technology and opportunity for Australia to take part in the nuclear fuel cycle.

Investigations have been wide-ranging and have included two overseas trips by working-party members, covering Washington, Ottawa, Bonn, Paris, London, Vienna, Brussels, Stockholm and Tokyo.

Here they have met with such experts as Dr Hans Blix, director of the International Atomic Energy Agency, and Dr Goldblat of the Stockholm International Peace Research Institute, and also visited fast-feeder reactors and other nuclear installations.

Rather than just information-gathering exercises, the visits have been an effort to try to find answers to the difficult and often conflicting views raised in the submissions.

One of the most contentious issues is just how safe international nuclear safeguards really are.

Predictably, the mining industry is convinced that the safeguards are adequate and if anything over strict. Pancontinental, for example, argues against stricter safeguards maintaining they are already the most stringent in the world. The time and effort needed to make them any stricter would be better used in developing international safeguard agreements.

Queensland Mines goes further, saying bilateral nuclear safeguards agreements are unnecessary and likely to create resentment in customer countries as well as much higher costs.

Equally predictably the anti-uranium groups take a very different view, arguing that present safeguards are totally inadequate.

The Australian Democrats Anti Uranium Action Group points out that safeguards, however strict, can never prevent diversion of nuclear material. Even if small quantities are discovered missing it will always be too late to prevent the diversion.

The Australian Conservation Foundation points out that the 1 to 1.5 per cent loss allowed by International Atomic Energy Agency inspectors can soon add up to enough plutonium to make many nuclear weapons.

Exactly what opinion the working party will reach on this crucial issue could well determine the whole tenor of the final report.

Another vital question is the effect of Australian participation in the nuclear fuel cycle and if it hinders or helps nuclear proliferation.

The mining companies are adamant that Australian participation is essential if the country is to exert any influence on nuclear-proliferation issues.

Energy Resources of Australia maintains that Australia furthers the whole cause of non-proliferation merely by being in the market place as a stable supplier of safeguarded uranium. Denison Australia even goes as far as to say that Australian refusal to supply uranium would harm non-proliferation.

But the anti-unranium groups all press for Australia to remain right out of the industry and instead back other measures to promote non-proliferation.

For example, the Australian Conservation Foundation suggests an alliance of middle-level non-nuclear countries to work for disarmament and for the establishment of an Australian Peace Research Institute.

It and other groups expressed concern at the safety of uranium workers, and of reprocessing and enrichment plants and all of course reject the mining and export of uranium outright.

The final crucial question is waste management and disposal. Some submissions, such as that from Western Mining, maintain that present waste-disposal methods using borosilicate glass are safe, while others argue for more work on Australia's own waste-disposal system, Synroc, developed by Professor Ted Ringwood of the Australian National University.

He has made his own submission and put forward yet another plan for its further development. This time he suggests an international cooperative effort to demonstrate the feasibility of disposing of high-level nuclear waste in deep drill holes in Australia.

He says this should be done with actual radioactive samples burying up to 50kg of Synroc in 15cm diameter holes, 2km beneath the earth's surface.

But not everybody supports Synroc and the Coalition for a Nuclear Free Australia raises strong doubts about Synroc's safety

Some of the submissions are definite wildcards, such as that from Mr J.W. Paull of St Kilda in Melbourne who strongly recommends that nuclear waste should be disposed of by dropping it from a plane into the mouths of active volcanoes.

Whether this is to ensure that the waste is distributed around the world in a cloud of volcanic dust or that it is demobilised by the intense volcanic heat is not made clear — but this seems to be one submission that ASTEC will not be taking too seriously.

Others have specific concerns, such as the need to establish a uranium enrichment industry in South Australia.

One of the most considered comes from the Northern Lands Council, which is concerned about the environmental problems of uranium tailings heaps on Aboriginal land.

It makes no pronouncement on the rights and wrongs of mining, just recommends the establishment of a national registry of radioactive tailings sites which will give the exact location and condition of every site and be kept for posterity.

But perhaps a final word should go to the Reverend Philip Huggins of North Nar Nar Goon in Victoria who felt so moved by the whole issue of nuclear proliferation and war

that he felt impelled to write to the inquiry on Christmas Day.

"Why do I do this?" he asks. "Because of the beauty of Christmas in comparison to the ugliness of uranium mining in cur wilderness areas and the particular ends of nuclear weapons proliferation.

CSO: 5100/4365

CALL MADE FOR PUBLIC INQUIRY INTO DAYA BAY NUCLEAR PLANT

Hong Kong HONGKONG STANDARD in English 9 Mar 84 p 3

[Article by San Kong]

[Text] THREE pressure groups want a commission of public enquiry set up to examine the economic and safety aspects of the proposed nuclear power plant project at Daya Bay, before an irrevocable commitment is made.

At a press conference yesterday, a spokesman for the Joint Organisation of the Concerned for Nuclear Energy in Hongkong (JOCNE) said this was to facilitate and guarantee public consultation.

"The joint organisation together with Hongkong Friends of the Earth (HKFOE) and Coalition for the Monitoring of Public Utilities will submit a formal proposal calling for the public enquiry to the Hongkong government," Miss Trini Leung said.

"A copy of this statement will also be sent to each Executive and Legislative Council member, Urban Council member, and to a number of District Board members, to seek their support," she added.

A mass rally will be held within the next two or three weeks to push this proposal, she said.

Five Urban Council members, Mrs Elsie Elliot, Mr Fung Kin-kee, Mr Pao Ping-wing, and Mr Lee Chik-yuet, have given their support to the proposal, she said.

Mr Lau Chin-shek, a spokesman for the Coalition for the Monitoring of Public Utilities, said they plan to persuade Legco members to put up a motion to debate the Daya Bay nuclear plant issue.

Referring to the call for a public enquiry, Miss Leung quoted the example of Sizewell, a small town on the east coast of England which faced similar problems. She said an enquiry was being held there.

She listed out the questions the public enquiry should investigate :

- Whether Hongkong will benefit in economic terms from participating in the Daya Bay nuclear plant project.
- Whether adequate studies have been carried out by the Hongkong Nuclear Investment Co regarding all aspects of the environmental impact of the Daya Bay plant on Hongkong.
- Whether adequate safety control will be ensured by the Hongkong Investment Co during the construction, commissioning and operation of the Daya Bay plant.
- Whether adequate contingency plans have been prepared by the Hongkong government to protect the health and safety of the population in Hongkong in the event of an unexpected problem at the plant.

The pressure groups also suggested a schedule for public enquiry.

- Before June 30, 1984: appointment of an indepen-

dent commissioner, who will be responsible for forming a coordinating committee for the inquiry.

- From September 1 to December 31, 1984: submission of relevant documents and papers by proponents and objectors, all of which will be open to public scrutiny.
- From February 1 to April 30, 1985: public hearings.
- From May 1 to June 30, 1985: evaluation by the commissioner and panel.
- July 31, 1985: publication of the findings, including the verdict and the reasons behind the decision.

Miss Leung suggested that the independent commissioner should be a person like a High Court judge.

She also said, "The Hongkong government and China Light & Power Co would be expected to be proponents, while the JOCNE and HKFOE would both expect to appear as formal objectors at the enquiry. Their case would be presented by expert witnesses and consultants, both local and overseas. Other citizens' organisations and individuals could participate as examiners and witnesses."

At the press conference, Miss Leung also repeated the call demanding the release of all feasibility studies by the government and China Light & Power Co.

Miss Leung said the government has given no reasonable justification for withholding these economic and scientific studies from the public.

She also said the announcement by Hongkong Electric Co last week, which said it would not be buying power nor investing in the Daya Bay nuclear project, appears to confirm doubts about the economic viability of the project.

She also rejected an argument by Secretary for Economic Services Mr Piers Jacobs. He had said there was no reason for providing any contingency or evacuation plans for the Hongkong population as an accident from the nuclear power station was very unlikely.

Miss Leung said even conventional power plants can face unexpected problems, and cited Sunday's blackout which affected the whole of Kowloon and the New Territories and parts of Hongkong Island as an example.

It was caused by "system disturbance" in China Light & Power's three coal-fired generators at Castle Peak, according to the company.

It demonstrated the ease with which disastrous mechanical failures could occur even in conventional power plants, she said.

"As a CLP official put it, last Sunday's blackout was a 'billion-to-one chance'. A similiar unexpected mechanical or design failure in a nuclear power plant could result in a catastrophe of enormous proportions," she said.

"It illustrates the essential need for a stringent, fully empowered and independent quality control panel to overlook the construction, commissioning and operation of the nuclear power station in order to ensure maximum safety," she said.

CSO: 5100/7521

ZHANG AIPING ADDRESSES NUCLEAR SOCIETY

OW111647 Beijing XINHUA in English 1636 GMT 11 Apr 84

[Text] Beijing, April 11 (XINHUA) -- China has built up a fairly comprehensive nucle industry and will from now on turn to applying nuclear technology in economic develop and improvement of people's living standard. This was announced here today by Zhang Aiping, state councillor and defense minister, when he addressed the opening ceremony the Second Congress of the Chinese Nuclear Society.

Pointing to the profitability in the utilization of nuclear energy, Zhang, however, w ed that greater attention must be paid to safety measures, including after-treatment the nuclear fuel. The industry, while quite capable of handling after-treatment, sho go on improving the facilities and technique in this respect for the development of t country's nuclear power industry, he said. He stressed the need to popularize the knowledge about the peaceful utilization of nuclear energy so as to dispel misgivings and apprehension concerning the use of nuclear energy.

Another speaker, Minister of Nuclear Industry Jiang Xinxiong, said that China planned build a number of nuclear power stations before the year 2000 and be self-sufficient nuclear fuel. The minister explained that China is well-endowed in uranium resources and has a fairly adequate nuclear fuel reprocessing system and a contingent of capabl nuclear scientists and engineers. Thus, the nuclear industry has been developing qui satisfactorily, he added.

At present, he went on, construction of two nuclear power stations is underway, one i Zhejiang Province and the other in Guangdong. Development of second and third genera- tions of nuclear power stations -- fast neutron breeder reactor and controlled nuclea fusion reactor -- as well as of material test reactor is making progress. He noted t nuclear technology and isotopes are being ever more widely used in China in medical care, agriculture, and food, chemical, and other industries, with heartening economic results.

CSO: 5100/4121

DEVELOPMENT OF BOILING-WATER GRAPHITE MODERATED REACTOR IN USSR OUTLINED

Chongqing HEDONGLI GONGCHENG in Chinese Vol 4 No 4, 1983 pp 72-79

[Article by Dong Yin [5516 5419] and Yang Shuiquan [2799 3055 3123]: "Development of Boiling-Water Reactor (Graphite Moderated) in the USSR"]

[Text] The Soviet large power boiling water cooled and graphite moderated reactor has a number of advantages. According to reports, the Soviet Union is building and plans to build two types of nuclear power plants: graphite moderated boiling-water reactor and pressurized-water reactor. Their technical strategy in nuclear power development is to give priority to the development of large power graphite moderated boiling water reactors (single station powers of 1,000, 1,500, 2,000 and 2,400 MW) while at the same time building 1,000 MW PWR power plants. In this article we briefly introduce the development status of the Soviet PБМК [RBMK] graphite moderated boiling-water reactor power plant.

I. Introduction

The Soviet power reactor using graphite moderated and boiling water cooling was developed from its military nuclear reactor. In July of 1944 the first Soviet graphite zero power device reached critical. From 1947 to 1952, the Soviet Union subsequently built six light water reactors using natural uranium and graphite in the Urals. On this basis they have conducted graphite LWR research and development since the early 1950's. On 27 June 1954, the first Soviet nuclear power plant with 5,000 kW power went into operation in Obninsk near Moscow. From 1958 to 1964, six more single reactor 100 MW nuclear power plants were built. They are of the Siberia pressurized tube type light water reactor using natural uranium as fuel and graphite as moderator and serve the dual purpose of electric power production and plutonium production. At this stage, the Soviet Union finished its first phase of developing pressurized tube graphite and light water power reactor. The second phase is marked by the construction of the 300 MW Beloyarsk power plant with dual reactors (one 100 MW reactor and one 200 MW reactor). The two reactors were built and put into operation in the period of September 1963 to December 1967 and the main feature is the achievement of industrial level nuclear superheating in the reactors. The year 1973 saw the start-up of the first PБМК-1000 graphite boiling water reactor in Leningrad which went into industrial operation at the end of 1973 and achieved rated power in 1974.

After that the graphite boiling-water reactor entered the const[illegible]tion phase of 1,000 MW commercial-scale power stations. In 1975 and 1979, the second and third similar devices were put into operation. Today these three reactors in Leningrad are operating reliably and steadily and carry a basic load in the power grid. In addition to these three reactors, two more РБМК-1000 reactors are also operating safely in Kursk and Chernobyl power plants. Today the total power of Soviet nuclear power plants already in operation and under construction is 20,000 MW. In their 10th Five-Year Plan, more than half of the nuclear power is produced by РБМК-1000 reactors. The 11th Five-Year Plan and 5-year plans after that, all call for the development of РБМК-1000 and РБМК-1500 pressurized tube graphite boiling-water reactors. Each 1,000 MW reactor is equipped with two 500 MW turbine generators and each 1,500 MW reactor is equipped with two 750 MW turbine generators. The power production costs of the РБМК-1000 and the РБМК-1500 are respectively 0.617 and 0.543 kopek/kwh, the latter is 14 percent lower than the former.

Reports show that there will be large developments in the Soviet's nuclear power industry in the next 10 years. Their technical strategy is to give priority to the development of graphite boiling-water reactor power plants while building 1,000 MW PWR power plants. According to a report in the first issue in 1981 of the Soviet journal ATOMIC ENERGY, the total power of Soviet nuclear power plants already in operation is 12,910 MW (approximately 5 percent of total electrical power generation capacity) and out of which 7,955 MW were produced by graphite reactors, which account for 61.6 percent of the total nuclear power (see Table 1).

II. Characteristics of Graphite Moderated Boiling-Water Reactors

Graphite moderated boiling-water reactors have the following features

(1) This type of reactor uses a direct circulation of steam in a single loop, the system layout is simplified and there is no need to have a large pressure vessel, a large steam generator, a high pressure circulation water main pump, extra-large diameter high-temperature and high-pressure pipes in the primary circuit and the associated components. The steam is generated directly in the reactor and, after steam-water separation, is fed into the turbine. After the steam does the work, it is condensed and returned to the reactor, thereby achieving the simplest conversion from steam energy to electrical energy. The cooling return circuit of the reactor is a 60-90 kg/cm^2 medium pressure system and is easy to operate and maintain.

(2) Each process tube in a pressurized tube reactor is an independent heating unit and its operating conditions such as temperature, flow rate and humidity may be independently monitored. To increase the reactor power, one is not limited by the manufacture ability of pressure vessels, and the difficulties of transporting large bulky equipment are avoided. The pressurized tube may make use of standard components.

(3) When graphite is used as the material for the moderator and reflector, it can be machined into various shape and dimension at a low cost. Graphite has good nuclear characteristics, it is a good moderator and reflector material,

only next to heavy water, and it has a higher moderation ratio and reflection coefficient than beryllium oxide and beryllium.

(4) In a graphite boiling-water reactor the loading and unloading of fuel and the changing of malfunctioned tube can be done without shutting down the reactor. This helps to increase the utilization rate of the facility and the load factor of the nuclear power plant. At the present time the average load factor is 0.65-0.74.

(5) The graphite reactors, however, do have a large volume and require more on-site installation work and a longer construction period and the reactor core requires more fuel. The electricity generation cost of graphite reactors with a power less than 1,000 MWe cannot compete with PWR power plants.

III. PБMK-1000 Reactor Core Construction

Based on physical and heat engineering calculations, the PБMK reactor core (Figs. 1 and 2) is cylindrical in shape, its equivalent diameter is 11.8 m, its height is 7 m, the thickness of the side reflector is 1 m and the thickness of the top and bottom reflector is 0.5 m. The reactor core consists of the fuel rods, the moderator, the coolant, the process tubes and the control rods. The graphite pile has 2,488 square rods with a cross-sectional area of 250 x 250 mm^2. The density of the graphite is 1.65 g/cm^3. The square rod has a 114 mm diameter round hole (graphite channel) to accommodate the process tube. Graphite rods are inserted into the outer four layers of graphite blocks and process tubes are inserted into the channel of the central 1,693 graphite blocks. The process tubes are made of zirconium alloy and is 88 mm in diameter and 4 mm thick. The coolant, nitrogen gas or a mixture of nitrogen and helium, flows through the opening between the graphite channel and the tube to carry away the heat of the graphite pile. The tube contains two fuel assemblies, 3.5 m long each and connected mechanically. The gap between the fuel assemblies is approximately 20 mm. Each fuel assembly consists of 18 fuel rods with a 12 mm diameter weight supporting zirconium rod at the center. The 18 fuel rods are held in position by a zirconium alloy frame (15 x 125 mm). The fuel rods have an outer diameter of 13.5 mm and the zirconium tube with a wall thickness of 0.9 mm houses UO_2 core blocks of 11.5 mm diameter and a density less than 10.5 g/cm^3. The concentration of ^{235}U is 1.8 percent or 2 percent. The space inside the fuel tube wall is filled with a mixture of argon and helium gas and the tube is sealed off by electron beam welding.

The coolant flows from the bottom to the top in the process tube. As water flows upward from the bottom of the reactor core and reaches a height of 2.5 meters, it is heated to the saturation temperature. Boiling takes place from here onward and at the reactor core outlet the average stream content in the water is 14.5 percent.

The channels for the monitor system and the control system are identical to the channels for the process tube and are located in the central part of the square lattice graphite pile. There are a total of 179 channels and they make a 45° angle with the process tube channels. There are four different

Table 1. Soviet Nuclear Power Stations in Operation as of June 1980

Number	Station name	Time from start-up of first reactor to last reactor(year)	Total power (10MWe)	Reactor type	Remarks
1	Obninsk	1954, June	0.5	Graphite PWR with small circuit	
2	Novosibirsk	1958-1964	6x10	Graphite PWR for plutonium production and electricity generation	Phase I, total power: 605 MWe
3	Novovoronezh	1964-1980	245.5	Four 440 MWe PWR one 1,000 MW PWR	
4	Beloyarsk	1964-1980	90	1x100, 1x200 MWe graphite nuclear superheating reactors, 1x600 MWe sodium cooled fast [neutron] reactor	Phase II, total power: 3,477 MWe
5	(Wulinqyang-nuofusike)	1965-1969	6.2	1x2 MW boiling-water reactor, 1x60 MW bH-60 fast [neutron] reactor	
6	Kursk	1973-1976	2x44	PWR	
7	Bilibino	1973	4.8	Pressurized tube graphite boiling water reactor	Phase II late stage total power: 1,228 MWe
8	(Xuefuling-hosike)	1973	35	БН-350 sodium cooled fast [neutron] reactor	
9	Armenian-2	1976-1979	81	PWR	Phase III, begin batch construction of РБМК power stations, total power: 7,810 MWe
10	Leningrad	1973-1979	3x100	РБМК-1000	
11	Kursk	1976-1979	2x100	"	
12	Chernobyo	1977-1979	2x100	"	

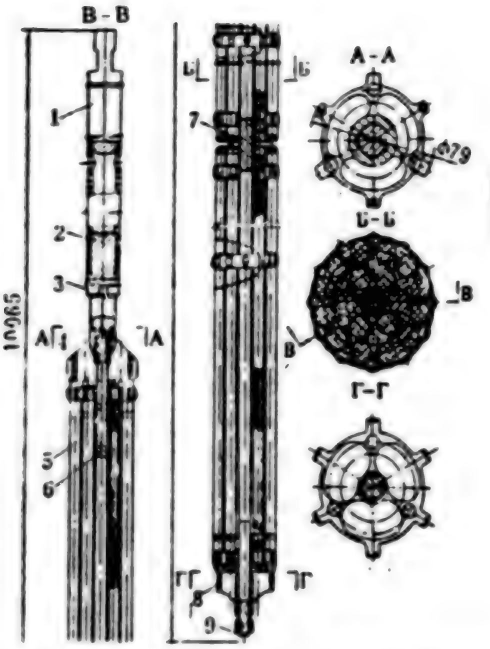


Fig. 1. PbMK Reactor Heat Releasing Element Assembly

Key:

1. Hanging rod
2. Cotter pin
3. Transition section
4. Terminal head
5. Fuel element
6. Weight supporting rod
7. Sleeve tube
8. Tail end
9. Screw nut

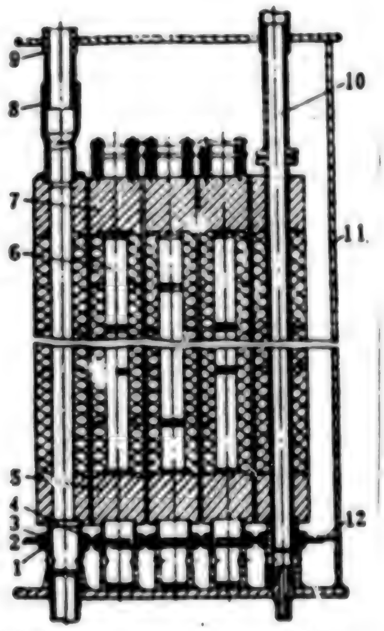


Fig. 2. Graphite Pile

Key:

1. Washer
2. Separation plate
3. Washer
4. Support cup
5. Steel support plate
6. Graphite plug
7. Protection top plate
8. Connection sleeve
9. Guide tube
10. Iron rod
11. Reactor inner shell
12. Steel ring

kinds of control rods: the radial power distribution regulator rod, the power level automatic regulation rod, accident prevention rod and axial power distribution regulator rod. The first three types of control rods move from the top downward and the last type moves from the bottom upward. Like the process tube channels, the control rod channels are also made of zirconium alloy. They have a diameter of 88 mm, a wall thickness of 3 mm and have graphite sleeve on the outside.

IV. Graphite Pile

The graphite pile (see Fig. 2) is mounted on a metal structure and weighs 1,700 tons. The graphite blocks have a cross-sectional area of 250 x 250 mm^2 and have four different lengths: 200, 300, 500 and 600 mm. Most of the blocks are 600 mm long. Each graphite square rod is mounted on a steel support plate (5) and sits on top of a support cup (4). The top part is fixed to a guide tube (9) coaxially aligned with the graphite square rod. The guide tube is welded to the top metal structure and is connected with the sleeve (8) through the top protection plate (7). The lower separation plate (2) is held fixed on the support cup with washers (1, 3), and the iron rod (10) prevents the graphite blocks from radial displacement. The lower separation plate is a stand-alone steel plate made of 08Cr18Ni10Ti and is 5 mm thick. The gap between the bottom plate and the reactor inner shell (11) is sealed off by a steel ring (12).

V. Primary Process Circulation System of the PБMK Reactor

The reactor core of a PБMK graphite boiling water reactor is housed in a 21.6 x 21.6 x 25.5 m^3 concrete well. The graphite pile is cylindrical in shape, surrounded by a steel cylindrical shell, and has metal structures both above and below. To improve the heat conductivity of the graphite and to prevent it from oxidation, the graphite pile is filled with a mixture of helium (40 percent) and nitrogen. The reactor is surrounded by biological shields on the top, at the bottom and on the side. The reactor core has a total of 1,693 process channels and 179 channels for control rods and monitor probes.

The temperature in the primary circulation system of the reactor is 270°C. Water at a pressure of 90 kg/cm^2 comes out of the high pressure primary pipe, flows through the regulator valve and the stand pipe and enters the process tube. Water flows from the bottom to the top and carries out the heat. The water is heated to the saturation temperature and is partially vaporized. The average steam content at the reactor core outlet is 14.5 percent. The steam-water mixture flows out of the core and enters the steam-water separator along the primary return circuit. After separation, the steam at a temperature of 284°C and a pressure of 70 kg/cm^2 enters the turbine at a rate of 5,400 tons/hour. After the steam condenses and goes through regenerative preheating, it is mixed with the water flowing out of the steam-water separator, it is then pumped into the primary pipe and forced into the main pump high-pressure pipe by the main circulation pump.

The reactor is loaded or unloaded without shutting down. At the normal speed of the fuel loader, 1-2 fuel assemblies can be loaded in 24 hours. The maximum number of fuel assemblies that can be loaded in 24 hours is 5. When the reactor is shut down, some of the fuel assemblies can also be replaced manually for a short period of time.

The monitoring system is installed for the reactor processing tubes gives full information on the operating condition of the reactor, the working condition and signals of the control and regulating system are displayed for each process tube. The incidence signal system has the following components:

(1) Physical monitoring system for radial and axial energy release,

(2) Process tube leak detection system,

(3) Monitor system for fuel rod integrity in each process tube,

(4) Flow rate monitor system for process tube cooling water,

(5) Temperature monitor system for graphite and metal structures.

The monitor data of these systems are processed by the unit automatic monitor system of the nuclear power plant.

The major parameters of the reactor are:

Thermal power 3,200 MW, average fuel burning depth 18,500 MW.day/ton.
Electric power 1,000 MW, total coolant flow rate 3.75 x 10^3 ton/hour.
Height of reactor core 7m, steam flow rate of steam generator 5,468 ton/hour.
Reactor core diameter 11.8 m, steam pressure in steam-water separator 70 kg/cm^2.
Grid separation 250x250 mm, pressure at high pressure collector tube 82.7 kg/cm^2.
Number of process tubes 1,693, steam content at outlet of reactor 14.5 percent.
Fuel enrichment factor 1.8 ^{235}U, coolant intake temperature 270°C.
Maximum temperature at specific point in graphite 750°C, coolant outlet temperature 284°C.
Maximum surface temperature of zirconium process tube 325°C, designed lifetime of reactor 30 years.

VI. Fuel Assembly

Major operating parameters of fuel assembly are:

Maximum power per tube 3,200 kW,
Water flow rate in process tube at maximum power 30.5 ton/hour,
Maximum steam content by weight at assembly outlet 19.6 percent,
Coolant pressure at assembly intake 79.6 kg/cm^2,
Maximum flow rate 18.5 m/sec,
Maximum outer surface temperature of assembly shroud 295°C,
Maximum inner surface temperature of assembly shroud 323°C,
Maximum center temperature of fuel block 2,100°C,
Maximum fuel consumption 24,000-28,000 MW.d/t UO_2,

Working time of fuel assembly in the reactor = 1,250-1,700 full power days at 24,000 MW.d/t UO_2.

The fuel assembly (Fig. 1) consists of the following main components: Two boxes of fuel rod bundles, suspending rod (grabber), terminal head, tailend and central weight supporting rod. The fuel box consists of 18 fuel rods, the grid and the frame. Fuel rods are interchangeable. The grid structure consists of 10 equally spaced grids and a tail grid attached to a central tube. The tail grid is attached to the central tube at the ream.

The fuel assembly has the following geometric dimensions and weight parameters:

Total length	10,065 mm
Maximum diameter	79 mm
Active section	
Maximum length	6,954 mm
Minimum length	6,920 mm
Weight	185 kg
Weight of UO_2	125-135 kg

Weight of corrosion resistant steel in active section $\leqslant$ 1.1 kg
Weight of zirconium alloy in active section $\leqslant$ 40 kg.

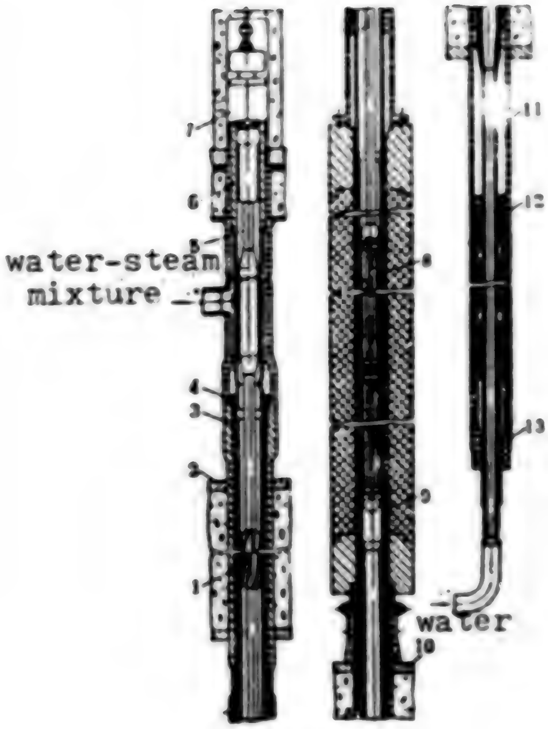
VII. Process Tube Channel

Table 1 shows the operation parameters of the process tube at rated power. If the life of the process tube is described in terms of the integrated neutron flux, then, for neutrons greater than 0.7 MeV in energy, the integrated flux may reach 3×10^{19} neutrons/cm^2.

Figure 3 shows the structure of the process tube channel. The body of the process tube is a welded structure, the central section is a smooth tube made of Zr + 2.5 percent Nb alloy and has a thickness of 4 mm and a diameter of 88 mm. The top section (3) and the bottom section (11) are stainless steel (08Cr18Ni10Ti) tubes and are welded to the zirconium alloy tube to obtain an absorption cross-section of σa = 0.02-0.03 barn in the reactor core and to satisfy the following mechanical and corrosion resistance performance at 350°C:

$\sigma_B > 25$ kg/cm^2 ($\sim$250 Mbar)
$\sigma_{0.2}$ 17 kg/cm^2 ($\sim$170 Mbar)
$\delta \doteq 15$ percent

The connection between the central zirconium tube and the upper and lower stainless steel tubes is made using a diffusion welding method to achieve a zirconium-steel transition section, see Fig. 4. The main body of the transition section is the zirconium tube and the outer hoop is made of Austenite stainless steel. This welding technique must satisfy thickness requirement and composition requirement in the diffusion zone and the weld must be corrosion resistant in the steam-water mixture and the helium-nitrogen atmosphere.



Key:
1. Steel plug
2. Metal structure at the upper part of structure
3. Lower stainless steel tube
4. Weld seam
5. Suspension rod
6. Outer ring
7. Close-off plug
8. Graphite sleeve
9. Zirconium tube
10. Metal structure at lower part of reactor
11. Sleeve
12. Membrane box compensator
13. Seal

Fig. 3. Structure of the Process Tube Channel

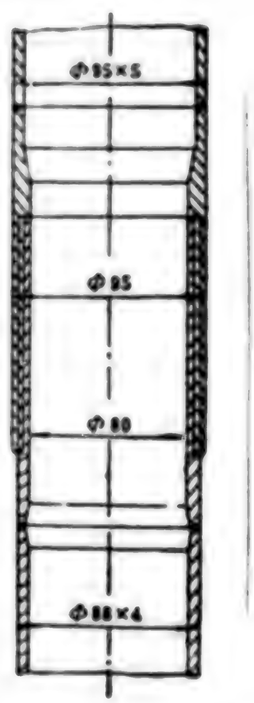


Fig. 4. Steel-zirconium Joint

The zirconium tube of the transition section is then welded to the zirconium process tube and the stainless steel parts are welded to the upper and lower stainless steel tubes. The weld seam and vicinity are then heat treated. The lower part of the process tube then goes through the membrane box compensator (12) and is welded to the guide tube of the metal structure. The outside of the membrane box compensator is then sealed off (13). The designed life of the process tube body is 25-30 years and can be replaced with special tools after the reactor is shut down.

On the upper end of the fuel assembly suspension rod, a close-off plug (7) is installed. It sits within the outer ring (6) and keeps the fuel assembly situated at the reactor core location in the process tube. It allows the refueler to change fuel without shutting down the reactor. A steel plug (1) is installed between the fuel assembly and the close-off plug as a biological shield.

In addition to the process channel, there are also the following channels:

179 channels for the control protection system
12 channels for energy release monitor probes (laid out axially)
4 channels for the start-up of the ionization fission chamber
156 channels for reflector coolant

In addition, there are more graphite channels outside the process tube grid for measurement purposes: 8 in the flat zone, 4 in the side reflector and 8 in the support and upper protection cover. Also outside the process tube grid, there are 24 ionization chamber channels, 20 for operation and 4 for start-up.

The channel structure of the control and protection system (Fig. 5) is identical to that of the (axial) energy release monitor and fission chamber. Their cooling water systems are also identical. The head (4) of the control and protection system channel acts as a guide tube for fixing the execution mechanism and for the entrance of the cooling water. The control and protection system tube, energy release monitor head tube and the ionization chamber tube are all "blind" welded to the water system tube with thrust cones. The structure of the lower water supply tube of special channels is different from that of process tubes. It has a lens-shaped compensator (6) and a regulator gate (7) to produce resistance.

The reflector cooling tube (Fig. 6) is mainly used for the cooling of the side reflection graphite blocks (4). A hold-down iron rod (5) is used to fix the side reflector in place.

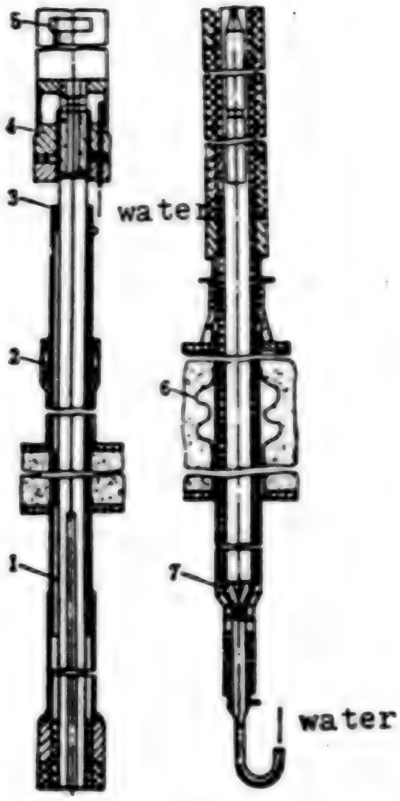


Fig. 5. Control and Protection System Channel

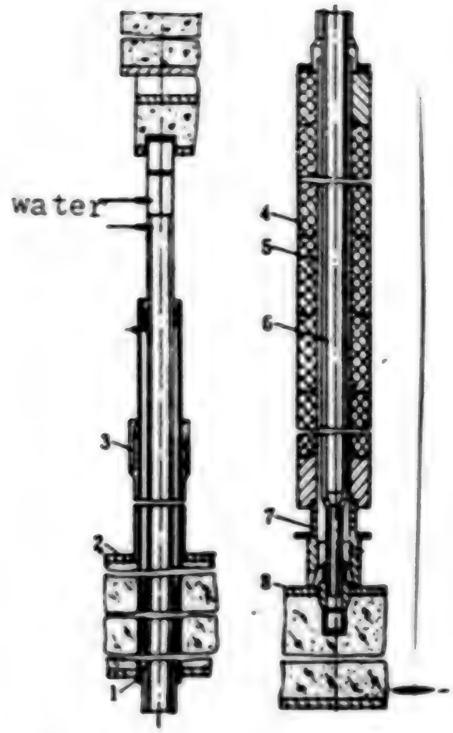


Fig. 6. Reflector Cooling Channel

Key:
1. Control and protection system channel
2. Membrane box
3. "Blind" weld seam
4. Head
5. Execution mechanism
6. Compensator
7. Regulator gate

Key:
1. Upper water system sleeve
2. Upper metal structure
3. Membrane box compensator
4. Side reflector
5. Iron hold-down rod
6. U-shaped pilot tube
7. Support cup
8. Lower metal structure

VIII. Shielding Structure of the Reactor Body

The body of the PБMK reactor is situated in a concrete well (Fig. 7). Shielding materials are steel, serpentine sand, water, structural steel, sand, heavy concrete and ordinary concrete.

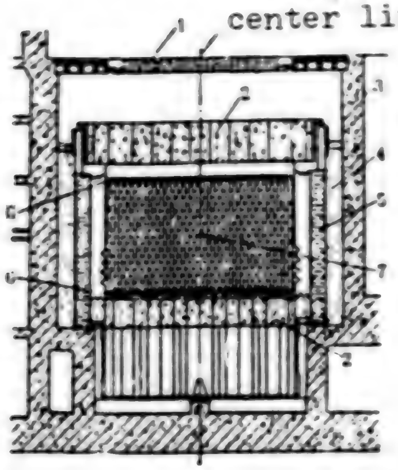


Fig. 7. РБМК Reactor Shield

Key:

1. Upper slab (heavy concrete, 4 ton/m^3)
2. Serpentine filling (1.7 ton/m)
3. Ordinary concrete (2.3 ton/m^3)
4. Sand (1.3 ton/m^3)
5. Protection water tank
6. Steel protection block
7. Graphite pile

IX. Operation Parameters of the РБМК-1000 Nuclear Power Plant

1. Versatility of operation

Regulation range permitted by load: 50-100 percent of rated power

Rate change permitted by load (percent of rated power per minute)

For 10-70 percent of rated power:	2-3
For 70-100 percent of rated power:	1
Start-up from cold state:	0.3
Start-up from hot state:	1-2
Rate of heating at start-up permitted by heat carrying agent	20°C/hr
Power device start-up time (hours)	
From short period of hot state	3-8
After shutdown	2
From long period of hot state	20
After shutdown	6
From long period of hot state	40-60
After shutdown	12-15
From long period of cold state	40-60
After shutdown	20-24

2. Important data during operation

Flow rate of nitrogen or nitrogen-helium mixture passing through the reactor graphite pile	(8.0-11.0) x 10^{-2} standard m^3/sec
Maximum temperature of reactor graphite pile	< 1,023°K
Steam pressure in steam-water separator	6.4-6.8 Mbar
Humidity of steam at the outlet of the steam-water separator	≤ 0.02 percent
Pressure of fore steam of turbine	6.1-6.5 Mbar
Total steam flow rate of the two turbines	1,500 kg/sec
Temperature of new steam	553°K
Pressure in the turbine condenser	(4.2-4.9) x 10^{-3} Mbar
Feedwater flow rate	1.5 m^3/sec
Feedwater temperature	438°K

3. Water Quality Standard in the Return Circuit Under Normal Operating Conditions

Standard	Return water	Feedwater	Purified condensed water
pH value	6.5-8.0	6.9-7.2	7.0
Concentration (mg/kg)			
Oxygen	--	≤0.02	≤0.05
Chlorine	0.1	≤0.04	≤0.01
Silicic acid	≤0.5-1.0	--	--
Hardness (mg equivalent/kg)	≤5	--	≤0.1
Specific conductivity (10^{-6} cm/cm)	≤1.0	0.1	0.1
Concentration (mg/kg)			
Iron corrosion products	≤0.05	≤0.005	≤0.01
Copper corrosion products	0.02-0.05	≤0.002	≤0.002
Sodium	--	--	≤0.003
Oil content (mg/kg)	≤0.2	≤0.1	--
Specific radioactivity (Curie/l) under normal operation	1×10^{-6}-2×10^{-5}		

X. Development Prospects

In order to improve the technical and economical characteristics of graphite boiling-water reactor nuclear power plants and give them a longer service life and better prospects for development, the Soviet Union further made the following technical improvements based on the consolidated experience of operating

existing graphite boiling-water reactor nuclear power plants for the multiple purpose of reducing the consumption of metal and raw material, reducing the capital construction investment, lowering the cost of power production, shortening the installation time, reducing the number of operators, lowering the dosage of radioactivity, improving the reliability and safety of the nuclear device and improving the versatility of the operation:

(1) In the reactor core design, the heat load and burning depth of the fuel unit have been improved. A reactor nuclear superheating technique was used in the steam supply system to improve the efficiency of the thermodynamic system. The thermal efficiency was increased from 31 percent to 37 percent. Compared with standard steam under the same pressure and producing the same electric power, the superheated steam at 450°C and under 65 kg/cm^2 of pressure can reduce the reactor heat power by 11-12 percent.

(2) The single reactor power was improved. Limited by the pressure vessel manufacture technology and transportation constraints, today's large PWR reactors have stabilized at a single reactor capacity of 1,000-1,300 MWe. Pressurized tube reactors are not subjected to these limitations. The Soviet Union is working on the operation, construction, development and design of a series of graphite boiling-water reactors with electrical powers of 1,000, 1,500, 2,000 and 2,400 MW. The actual operation of the PБMK-1000 reactors has shown that, since the heat engineering safety of critical heat exchange has a certain amount of allowance, heat exchange can be improved while keeping the structure and dimension of the reactor unchanged and thereby raising the power by about 50 percent.

(3) The enrichment of fuel was improved. Physical experiment and calculation have confirmed that the consumption of fuel rods and natural uranium may be reduced by improving the fuel enrichment and burning depth. For example, the consumption of fuel rods may be cut by 20-30 percent if the enrichment is raised from 1.8 percent to 2.0 percent. Calculations also showed that when the enrichment is increased from 1.8 percent to 3.0 percent, the ^{235}U content in the retired fuel will reach 0.25 percent. If the enrichment is increased from 1.8 percent to 3.6 percent, the ^{235}U content will reach 0.2 percent [sic]. The ^{235}U content in the spent fuel has reached the concentration in the tailing of uranium enrichment plants. Raising the fuel enrichment also increases the ratio of nuclear fuel to moderation agent. This causes a change of the steam reactivity coefficient in the reactor and can even change it from positive to negative. This has improved the stability of the reactor power distribution and safety.

(4) The reactor body was constructed by sections. The structure of the reactor body has made the transition from an integral structure to components that can be built section by section. For example the upper and lower steam intake and outlet systems on the reactor body may be built by parts and installed by section. This type of structural layout makes manufacture, transportation and installation easier and reduces the amount of on-site construction and installation. Installation by section is particularly significant in that it does not require great capital construction investments for building special, large architectural and mechanical facilities. In addition, most of the mechanical devices of a graphite boiling water reactor can be built in conventional machine plants.

9698
CSO: 8111/0243

FIGUEIREDO CRITICIZES TLATELOLCO TREATY

PA070038 Mexico City NOVEDADES in Spanish 31 Mar 84 pp 1, 11

["Part 2" of interview with President Joao Figueiredo by special reporter Joaquin Lopez-Doriga V., in Brazil; date not specified]

[Excerpt] Brasilia, 30 Mar -- President Joao Figueiredo today reasserted his refusal to sign the Tlatelolco Treaty and issued the harshest criticism ever against the agreement, describing it as partial, discriminatory, and incapable of banning the atom's use in war or of providing it for peace.

During an exclusive interview granted to NOVEDADES, the Brazilian head of state broadly rejected the Mexican treaty, saying it establishes unequal rights and obligations by institutionalizing an unacceptable division between countries with nuclear weapons and countries without nuclear weapons -- something his government rejects categorically. "It bans only the so-called horizontal proliferation by preventing the theoretical possibility of a future purchase of nuclear weapons by countries which do not have them; however, it does not mention the vertical proliferation, the real one, which is the stepped-up expansion and improvement of the great powers' nuclear arsenals."

The Arguments Continue

Expanding on his country's arguments for rejecting and opposing the agreement, the president said:

1. The Tlatelolco Treaty does not foresee any efficient system to protect the non-nuclear countries from an aggression by the nuclear powers.

2. The pledge to start, within a short time, the talks to halt the arms buildup and negotiate a general and complete agreement on disarmament is useless and obsolete. He recalled that the Tlatelolco Treaty was signed in 1968, 16 years ago, and nothing has been done to achieve its goals.

"In short, Tlatelolco disarms the countries which -- like Brazil -- are unarmed and have no intention of arming themselves. It has been incapable of providing the atom for peace or banning its use in a war. That is why the treaty is partial and discriminatory," he asserted.

Figueiredo described as "gross misinterpretations" the stories that have circulated regarding a Brazil-FRG alliance to develop the former into a nuclear power in the military sector. "This is a myth because it violates the basis of Brazilian policy -- which has been proved because our country has signed every anti-nuclear treaty in the world except the Tlatelolco Treaty. We have maintained a firm and clear political position that rejects an arms buildup."

Rejection of the Arms Buildup

Figueiredo recalled that the joint communique signed during his visit to Mexico last year emphasized his rejection of the buildup of nuclear arsenals, because this endangers the survival of mankind on our planet.

He continued: "I wish to state clearly the absolutely peaceful plans that Brazil has regarding the atom's use. We do not pretend to be a nuclear power, and we are not allies of countries that believe this or use their nuclear power for destruction."

Asked whether the first nuclear reactor in Latin America already exists in Brazil, he replied: That is another gross misinterpretation. The question does not reflect our reality; it is wrong. "Your question represents another misinterpretation, because it takes for granted that Brazil has already installed the first nuclear reactor in the region."

He asserted that the Brazilian nuclear program has exclusively peaceful goals and seeks to solve the country's energy needs since it has the world's fifth largest uranium reserves. Once the nuclear procedures are controlled, the country will be free from its dependence on foreign energy sources and be able to fully exploit its industrial potential and fulfill any other type of national needs.

Brazil is currently importing 1 and 1/2 million barrels of oil per day. Its payments represent 30 percent of all its annual exports.

Figueiredo added: "I also want to tell you that the nuclear program is subject to a control and security system that is much more strict than the one foreseen in the Tlatelolco Treaty. Our system has been approved by unanimous decision and without modifications by the board of governors of the International Atomic Energy Agency."

Respect Toward Treaties

The president insisted: "We advocate the treaties that effectively prevent and control the spread of nuclear weapons and at the same time advocate the atom's use for peaceful goals, and this is not the case with the Tlatelolco Treaty."

CSO: 5100/2087

GUERREIRO NOTES POSSIBILITY OF NUCLEAR COOPERATION WITH INDIA

Sao Paulo FOLHA DE SAO PAULO in Portuguese 8 Mar 84 p 4

[Text] New Delhi--On completing a 4-day official visit to India yesterday, Foreign Minister Saraiva Guerreiro said that Brazil and that country could establish mutual cooperation in various sectors including nuclear energy. Guerreiro pointed out that Brazil is a country rich in uranium reserves but does not have the technological capability to enrich it on a commercial scale. In this regard, India is the most advanced country in the Third World in the field of nuclear technology.

The Brazilian minister also announced the formation of a joint Brazil-India commission to analyze cooperation between the two countries periodically. The commission, which will be headed by the respective foreign ministers, will begin its activities the second half of this month.

Guerreiro described his visit to India, the first by a Brazilian foreign minister in the last 16 years, as "useful and constructive." He met with Prime Minister Indira Gandhi, his counterpart P. V. Narasimha Rao and Minister of Commerce V. P. Singh, with whom he agreed that the two sides will adopt measures aimed at facilitating bilateral trade, currently $250 million and heavily favorable to Brazil.

The Brazilian foreign minister declared also that the two governments are aware that one of the ways to increase bilateral trade will be through a regular shipping line. "India and Brazil cooperation very much in international organizations, in the United Nations and its agencies. They have very good bilateral relations but there is little trade; there is little concrete cooperation. In any case, that type of cooperation is much short of the potential of the two countries."

Saraiva Guerreiro traveled in the company of the president of the Sao Paulo State Federation of Industries (FIESP), Luiz Eulalio de Bueno Vidigal Filho; the president of the Association of Brazilian Exporters, Laerte Setubal; and the president of the National Council of Science and Technology, Linaldo Cavaldanti. The two businessmen established contacts for the organization of an Indian business mission to Brazil in a future date.

8711
CSO: 5100/2086

BRIEFS

ANGRA-I OPERATIONS RESUME--The Angra-I nuclear plant stopped operations last week after operating since 28 February at 100 percent of its nominal power--calculated at 626 megawatts--and resumed the generation of power yesterday, already synchronized with the distribution system of the Southeast region, according to the information from the management of Furnas Electric Power Stations Corporation. The plant should once again reach 100 percent power within a few days because the power-raising process is gradual. It reached 626 megawatts and began normal supply of nuclear-derived electric power to the consumers of the Southeast on 28 February. On 4 March, it reduced its power to 75 percent for the inspection and cleaning of various filters of the water pumps in the plant's secondary cooling system. It remained in a test mode until it was shut down last week. Furnas Electric Power Stations revealed also that its electric power generation capacity showed an increase of 18.9 percent in the first 2 months of this year compared to the first 2 months of last year. [Text] [Rio de Janeiro JORNAL DO BRASIL in Portuguese 22 Mar 84 p 20] 8711

CSO: 5100/2086

BRIEFS

NUCLEAR SAFETY LAW SIGNED--President Augusto Pinochet has signed the nuclear safety law during a ceremony held in La Moneda Palace. The Chilean Nuclear Energy Commission [CCEN] will implement the law which has six chapters. The law establishes a system by which the CCEN will carry out safety control measures at nuclear plants. [Excerpt] [PY171330 Santiago Domestic Service in Spanish 1100 GMT 17 Apr 84]

CSO: 5100/2090

INDIAN DEFENSE OFFICIAL, PAKISTAN DIPLOMAT ON N-BOMB

Indian Defense Institute Director

Bombay THE TIMES OF INDIA in English Supplement 19 Mar 84 pp 1, 4

[Article by K. Subrahmanyam, director, Institute for Defence Studies and Analyses]

[Text]

EARLY in April 1979 the Indian minister for external affairs first disclosed in Parliament that Pakistani nuclear efforts had a non-peaceful dimension. This was the first official announcement to the world of Pakistan's efforts to make the bomb, though earlier in the autumn of 1968 the question of supply of inverters to Pakistan that could be used in the centrifuges had been raised in the British Parliament. A few days after the disclosure in the Indian Parliament came the announcement of the Carter administration that it was invoking the Symington amendment and cutting off all aid to Pakistan other than food aid. Then came the BBC T.V. programme, the Dutch Parliamentary Commission's report on the A. Q. Khan affair, the lengthy debates in the US Congress on the waiver of the Symington amendment and extension of arms aid, the book **Islamic Bomb**, hints from Washington of a Chinese-Pakistani link-up and speeches of US officials on the possibility of Pakistan reaching nuclear capability.

In India, too, over the last five years there have been a number of books, articles and monographs on whether Pakistan would succeed in going nuclear. All these developments have helped to condition the people in the subcontinent to accept the recent announcements of Dr. A. Q. Khan and General Zia on the issue of Pakistan attaining uranium enrichment capability without excitement or panic. One may contrast this to the Indian reaction to the Chinese nuclear weapon test in October 1964. It led Lal Bahadur Shastri to seek a nuclear umbrella from Britain and the Durgapur session of the ruling Congress party to debate India's nuclear policy options. No doubt there are differences in the two situations. Pakistan has not carried out a test and the Indian nuclear test is nearly ten years old. India is a far more self-confident country now than it was in 1964, barely two years after the debacle in the Kameng division in November 1962.

The Islamic Bomb

Since the publication of **Pakistan's Islamic Bomb** by Maj.-Gen. Palit and Namboodiri four years ago, there was a debate in this country on the strategic and political implications of Pakistan going nuclear. Some of it was redistillate of the western conventional wisdom but some of it was professional. The armed forces indicated their concern by organising a seminar in the United Services Institution and a postal seminar in the College of Combat. Now is an appropriate time to have a dispassionate, objective and unsentimental assessment of what a nuclear Pakistan implies for India's security.

At the outset let us disabuse our minds of the racist view that while the nuclear weapons are safe in the hands of the white and yellow races they cannot be trusted with black and brown leaders. The historical record shows that city busting was essentially a military tradition of the European and American nations. The prophet of city busting as a philosophy of waging war was the Italian General Giulio Douhet. Thereafter it was inherited by Marshal Herman Goering of the Luftwaffe and its most ardent devotees were the bomber Harris of the RAF and Carl Spaatz of the US air force backed by Lord Cherwell, scientific adviser to the British Prime Minister, and Winston Churchill himself. The use of nuclear weapons was itself a logical extension of this philosophy and the saturation bombing raids on cities flowing from it.

This tradition was continued further when the US air force dropped more explosives on the three Indochinese countries than had been cumulatively manufactured in all history up to that time. City destruction through nuclear weapons is traceable to the western philosophies of war. On the other hand the three and half Indo-Pakistan wars fought in the last thirty-seven years

have been conducted with due deference to laws of war and the Hague convention. No civilian targets were destroyed in these conflicts except inadvertently and that too rarely.

This does not, however, mean that Pakistani nuclear capability is of no concern to Indian security planners. It has a variety of implications, including many relating to conventional war scenarios. Unfortunately there is no ready-made model on the basis of which we can analyse the impact of Pakistani nuclear capability on the military equation of the two neighbours and we are compelled to fall back on empirical assessment.

Since the Pakistanis have reached the uranium enrichment capability it is to be assumed that they will be in a position to build up an arsenal of uranium bombs constrained only by the output of their centrifuge plant. In other words, as years go by, Pakistan will be in possession of several bombs widely dispersed over a number of locations. F-16 is designed as a nuclear weapon carrier though it is difficult to say at this stage whether Pakistanis have as yet been able to design a weapon within the weight range that can be fitted to F-16. But they have other aircraft as well. The first untested uranium bomb dropped over Hiroshima weighed a few tons and since then technology has made it possible to make weapons within much smaller weight ranges. In that respect plutonium lends itself to miniaturised bomb-making in a relatively more versatile fashion than uranium.

For the purpose of our analysis it may be assumed that Pakistan will adopt a strategy of ambivalence and will not carry out a nuclear test on its soil or declare itself to be a nuclear weapons power. The announcement that it has achieved the enrichment capability itself is a first major step in the implementation of this strategy. This strategy has several serious implications for a conventional war in the Indo-Pakistan context and this perhaps is the most important area deserving the attention of our military planners.

Nuclear Pak

With a nuclear Pakistan, even if it is in possession of only two or three crude uranium bombs, India's conventional superiority over it will lose much of its significance. The Indian defence planner has to take into account the risks in having his forces concentrated especially on the Pakistani soil. Any concentration of forces can offer a ready target for Pakistani nuclear weapons, especially on their own soil. If Pakistan were to use a nuclear weapon on its own territory to destroy a concentration of Indian force, world public opinion is not likely to condemn Pakistan since it would be deemed a defensive act. This might perhaps explain why Pakistan has not chosen to spend much on its armour modernisation. In plain terms, it has become necessary to review the question of Indian armour superiority acting as a deterrent.

Prof. Stephen Cohen, of the University of Illinois, who held discussions with the Pakistani military establishment on the rationale of its nuclear weapon programme as far back as early 1980 has recorded their arguments. According to them, a Pakistani nuclear capability would "neutralise an assumed Indian nuclear umbrella ...., a Pakistani nuclear capability paralyses not only the Indian nuclear decision but also Indian conventional forces and a brash, bold, Pakistani strike to liberate Kashmir might go unchallenged if the Indian leadership was weak or indecisive." It is in this connection one has to pay particular attention to Pakistan acquiring a vertical envelopment capability by integrating its armed helicopters with its army, developing the Skardu airfield and logistical network backed by the Karakoram highway.

The best use of the nuclear weapon is not to explode it in any target but to exploit it politically. The nuclear weapon has been converted into a currency of international power thanks to the legitimacy conferred on it by the non-proliferation treaty. Pakistanis have in the past proved themselves skilful in probing weaknesses in the Indian defences and taking full advantage of them. The Kutch operation and the effect on the Chhamb sector are two such examples. A nuclear Pakistan will be in a position to take similar advantage of any weaknesses in the long Indian defence line and to present India with the dilemma of either escalating the conflict with the possibility of involving the use of nuclear weapons or negotiating under duress.

Then there are the political implications. The scheme of SARC (South Asian Regional Cooperation) will assume a somewhat different character if Pakistan becomes a member of the nuclear club or even adopts a strategy of ambivalence and lets other nations realise through hints that it is in possession of an undeclared nuclear arsenal. Under such circumstances one wonders whether Pakistani or Bangladeshi foreign ministers will take the Indian foreign minister into confidence if they were to receive a future request for troops from Sri Lanka.

Bhutto's vision of nuclear Pakistan was not limited to its role in the subcontinent. He wanted Pakistan to claim the leadership of the Islamic world. The Arab world's morale is low and even an ambivalent posture on the part of Pakistan in regard to nuclear weapons would come as a great morale booster for it. In turn this could result in greater political and economic support for Pakistan by Arab states, especially of the Gulf area.

It could augment Pakistani leverage vis-a-vis the United States as well. States with a similar status — Israel and South Africa — are able to extract advantageous bargains from the US. President Reagan talks of constructive engagement with South Africa. Pakistan might also be able to persuade US Congressmen to take the view that a Pakistan with a possible nuclear deterrent would be able to stand up better against the Soviet Union as a frontline state. It may not be without significance that some democratic contenders in the Presidential race refused to subscribe to a declaration that all aid to Pakistan should stop if it conducts a nuclear test.

It is against such an overall assessment of military, political and strategic implications of a Pakistani nuclear capability that India has to formulate its policy to safeguard its security and national interests. In this exercise there is no room for sentimentality or pseudo-moralism.

* * *

MANY both inside and outside India assert that following the 1974 Pokhran test this country must have built up a limited nuclear arsenal and very often this is cited to justify the Pakistani nuclear weapon programme. The Indian nuclear test of 1974 triggered off many developments in respect of international nuclear relations. The advanced nuclear industrial nations formed the London Club and formulated a "trigger list" of items which were not to be exported. The peaceful nuclear explosion which was until then extolled as a major beneficial application of the constructive use of nuclear energy was projected as being no longer cost-effective.

The US came out with its own nuclear non-proliferation act. It is significant that in spite of the fact that all the above developments were a direct outcome of the Indian nuclear test, the penalties of the US non-proliferation act, invoked in the case of Pakistan in April 1979, were not applied to India. This clearly showed that the US administration which monitors the nuclear activities of all nations could not come to the conclusion that India had built up a nuclear arsenal, however small it may be. India is not one of the "favourite sons" of the US as Israel and South Africa are. The US administration has adopted an unhelpful line even in respect of reprocessing the reactor-grade Tarapur plutonium.

Every now and then a story is planted in the US media about some digging activity in Pokhran and it is used to justify the disowning of their contractual obligations by the US administration and its Congressmen. While in Pakistan's case the US administration had to waive the application of the Symington-Glenn Amendment to their non-proliferation act, such a contingency had not arisen in India's case. Therefore, we have to start with the assumption that in spite of the Pokhran test of 1974, India has no nuclear arsenal at present. It no doubt has the demonstrated capability to build one at short notice. A serious limitation is the availability of weapon-grade plutonium. Contrary to the disinformation put out by the US and western strategic literature, the Tarapur and Rajasthan reactor-grade plutonium is totally worthless in the manufacture of usable weapons. Hence our production capacity of Plutonium 239 necessary for weapons is limited by the CIRUS reactor's output. When the new reactor Dhruva is commissioned, it will augment our output.

Therefore, building up an arsenal is within our capability and since we have carried out a test it is also possible for the Indian scientific establishment to build similar plutonium devices without further testing, though a further improvement in design and going on to the thermonuclear stage will not be easy without a series of tests specifically aimed at improving yield-to-weight ratios.

Until now the Indian leadership has adopted the line that while India would not rule out further nuclear explosions if they were considered necessary to develop peaceful applications, it does not intend to build weapons. There is no Indian policy document in regard to our perceptions on the impact of nuclear weapons on our security. This, of course, is not unusual since the Government of India has never published a white paper on any subject except India-China relations. Even that was only a compilation of letters exchanged. Our service leaderships have not applied themselves seriously to the issue as is evident from the near total absence of pronouncements on this subject from retired senior level service officers. The same applies to the foreign office and defence civilian establishments too. Except for the former defence minister C. Subramaniam, the former home and finance minister H. M. Patel and the Energy Board chairman K. C. Pant no senior political leader has argued the issue. Others like Prime Minister Indira Gandhi, and ex-P.M.s Charan Singh and Morarji Desai have only made pronouncements on nuclear issues without any detailed supporting arguments. Therefore, the country is in a position to formulate a response to the present situation without being trammelled by any past policy constraints.

It is obvious that it is not in India's interest to become an overt nuclear weapon power in response to the Pakistani policy of ambivalence. That will itself provide Pakistan justification to declare itself a nuclear weapon power. On the other hand, the Indian objective should be to use Pakistan's overt nuclear declaration to justify its own programme. At the same time, Pakistan should not be left in any doubt that India would allow an asymmetric situation to develop. In the past, both in 1965 and 1971, misperceptions on the part of the Pakistani leadership led to their adventurism against India. Consequently the Indian response should also be a policy of ambivalence with enough hints to create an impression that the Indian policy is no longer one of total nuclear abstinence. To borrow a phrase from the Israelis, India should project an image that it may be harbouring some bombs in the basement with the last wire yet to be connected, and is hence technically not a nuclear weapon power, but for all practical purposes, it is one.

Different Strategies

The Pakistani strategy of ambivalence and India's strategy are different. Pakistan has attempted to create an impression that it has reached the stage of producing a weapon by announcing its enrichment capability. India, on the other hand, has to communicate to the world that it may have shed some of its inhibitions in regard to the development of its nuclear arsenal. This is somewhat more difficult since this involves a reversal of the image that has been built up over a period of time while in Pakistan's case it was a long-expected announcement.

The problem facing India is that this country's leadership does not boast a tradition of using ambivalence as a strategy while those in Pakistan and Israel are experienced practitioners of it. The art of ambivalence is to let people know one has capability and then to deny that the capability is backed by the intention to act. One would have to first drop hints that it may have to be deployed under certain contingencies, then further hints that such a course has been necessitated by external circumstances. The leadership would then have to deny the development, inspire those not in authority to disclose the possibility of it, allow discussions to take place on the general assumption of the capability. It would then have to once again officially deny the capability, release some partial but inadequate information about it, carry out actions which tend to reinforce suspicions, and yet vehemently deny having embarked on such a course of action. The Israelis have made the whole world believe they have an arsenal of nearly 200 weapons without carrying out a test on their soil and without incurring the penalties of the U.S. non-proliferation law. As far back as 1967, the practice of toss-bombing techniques by their aircraft led the CIA to suspect their capability. They shot down the Libyan airliner flying near Dimona, their nuclear centre. The Israeli President announced their capability to produce weapons but the government denied any intention of going nuclear. A whole series of articles was contributed by Israeli strategists on the last wire concept, the bomb in the basement, the use of ambivalence etc. The U.S. media including Time and Newsweek have disclosed how Israel, facing the possibility of defeat on October 10, 1973, was preparing to connect up the last wires and to use the weapons if the Arabs were to break through the Israeli front. Yet Israel blindly denies any possession of nuclear weapons, in spite of authenticated documentation of U.S. weapon-grade material having reached Israel clandestinely.

"Bhutto Must Go"

Similarly General Zia has been an artful practitioner of the strategy of ambivalence. He did this in respect of the Pakistani elections. To conduct them in a fair manner, he claimed he had to seize power and, to get rid of Zulfikar Ali Bhutto. He gave the assurance that not a single strand of Bhutto's hair would be harmed. He has been using the same strategy with regard to his military relationship with the U.S. and his nuclear weapons programme.

How does one carry out a strategy of ambivalence in respect of nuclear capability in the case of India? It is not feasible to discuss in an article those actions intended to convey to the world, especially to those who are monitoring the nuclear developments, the uncertainty that there may be some discontinuities in our policy of nuclear abstinence. But two steps can be publicly discussed. First, our practice of singing in chorus that India will never go nuclear and that nuclear energy will be used solely for peaceful purposes should be replaced by different government spokespersons speaking in different voices. While perhaps the Prime Minister should continue with the established declaratory policy pronouncements, the next level of leadership could express nuances of changes in their public pronouncements. For instance, the customary catch-all answer of the defence ministry that all developments that have a bearing on our security are monitored and necessary steps are taken to meet all contingencies could be modified to indicate a slight change. This is only by way of example and it is not necessarily recommended that this should be specifically done. Speeches of senior leaders could encompass the nuclear threat to the country and emphasise that our neighbours should not think in terms of nuclear blackmail and India would be able to meet it.

There should be greater encouragement towards public discussions, seminars, publications including those with participation of senior service personnel and ex-service personnel on the likely nuclear threats and steps to avert them. A little more attention to these issues in our military training institutions would be desirable. Some discussions on the civilian command and control in nuclear war contingency in the subcontinent will generate certain messages augmenting ambivalence. At the same time, our official policy at the highest level will continue to reiterate that India will not consider the use of nuclear energy for purposes other than civilian.

There will no doubt be many simple-minded and good-hearted souls who will be horrified by this strategy of ambivalence. They will once again recommend that India should join Pakistan in an arrangement for mutual inspection and for renunciation of nuclear weapons. Underlying such an approach is an implicit acceptance that Indians and Pakistanis cannot handle nuclear weapons and a nuclear strategy without dropping the bomb on each other. The assumption in this article is that the Pakistanis are no less rational than the westerners and they will not take undue risks if they do not woefully miscalculate. The way Generals Ayub Khan and Yahya Khan terminated the wars showed that their risk-taking propensities were constrained by rationality. General Zia, if at all, has shown himself to be very much shrewder, much more calculating and far less inclined to risk-taking.

To a large extent it is the self-obsession of the Indian elite which has led them to think that the sole justification for the Pakistani nuclear effort is India. Bhutto called the nuclear capability the "sword of Islam". Ali Mazrui has written about the nuclearisation of Islam. Francis Fukuyama of the Rand Corporation has said, "Acquisition of nuclear weapons is very much bound up with Pakistan's self-conception as the leaders of the Islamic world". It is a matter of national consensus in that country.

Therefore, our aim should be to devise ways and means of deterring Pakistan from taking undue risks. One need not contribute to the doctrine of deterrence to take steps to deter someone just as one need not be religious to respect the religious susceptibilities of others. So long as the Pakistanis and the rest of the world believe in the deterrence doctrine it should be possible for us to deter them, irrespective of whether we accept the doctrine of deterrence or not.

Former Pakistan Netherlands Envoy

Bombay THE TIMES OF INDIA in English Supplement 18 Mar 84 pp 1, 5

[Article by Sayyad Hyder]

[Text]

Recently the Indian government's policy research centre called together the country's civilian and military elite for a conference on India's security and the relevance of the nuclear option. The conference concluded that India would not be able to attack a nuclear weapons capable Pakistan as it had done in the 1971 Indo-Pak war. The present visit to Pakistan by the director-general of the IAEA, Mr. Hans Blix, provides us with an opportunity to assess where we stand, to examine our capabilities and the relevance of safeguards. We cannot hope to deter India unless we acquire a credible capability, given of course political progress, constitutional consolidation and socio-economic development and we cannot hope to project a deterrent credibility when we ourselves are still in the dark on this issue.

To a large extent our present strategic predicament is due to the late awakening nuclear vision of our leaders some 20 years after India, compounded by a continuing weakness in analysis and implementation. Our foreign policy strategists lack the rigour to master the technical and legal foundations while our scientists and nuclear administrators work in a vacuum dulled by the lack of public discussion and accountability.

The Indian nuclear effort predated partition. It concentrated on acquiring a modest unsafe-

guarded reactor and reprocessing capability within the published conceptual framework of a research and development plan culminating with breeders and, therefore, justifying the production and stockpiling of weapons grade plutonium. Not only was Pakistan slow in following this example but it based its international policy on the erroneous assumption that by joining in a campaign to safeguard India's programme, it could forestall that ominous day without realising that by so doing it was thus curtailing its own options.

Empirically speaking, while we developed our manpower base in the fifties and sixties, we did not begin planning to acquire the hardware. We made the grave mistake of going in for a safeguarded power reactor, Canadian KANUPP, instead of a relatively unsafeguarded research reactor. We are still paying for this decision. Again, in 1974, when Canada unilaterally abrogated its nuclear fuel supply contractual obligation, we did not avail ourselves of this opportunity to give a six months notice to terminate the underlying Pak-Canadian agreement on which the continued existence of the IAEA-administered trilateral safeguards depends. Instead, the late Prime Minister, Zulfikar Ali Bhutto, encouraged the development of our uranium centrifuge effort in comparative obscurity while the attention of the world was diverted to our public and eventually unsuccessful effort to obtain a commercial plutonium reprocessing plant from France.

However, while giving credit where it is due for recognising and developing the economic and security aspects of our nuclear policy, it must be stated that every head of state from President Ayub towards the end of his regime until President Zia-ul-Haq has faithfully carried on this question on which our survival may well depend.

Our relations with the IAEA over safeguards "are a reflection not only of a lack of clear thinking on our part but also of the evolving evaluation by the new director general of his post and responsibilities after taking over from his distinguished predecessor and compatriot, Mr. Sigvard Eklund, who served for twenty years. The moment the PAEC announced that it had succeeded in fabricating its own fuel for KANUPP in 1980, the IAEA began to worry that we might be able to utilise the on-loading system of such CANDU reactors for safeguards diversion.

The basic purpose of agency safeguards is to provide the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection. This purpose is served by the provision of material accountancy as a safeguards measure of fundamental importance and containment and surveillance as important complementary measures. Countries which have signed the NPT agree thereby to submit all their peaceful nuclear activities to IAEA safeguards. Hence for NPT signatories the IAEA has the right to worry about and to press safeguards on any suspected unsafeguarded facility.

In the case of non-NPT countries such as Brazil, Argentina, Pakistan and India, the IAEA can only concern itself with safeguarding specific projects through implementing agreements concluded by sovereign states and containing specific methods for safeguards implementation arrived at through negotiation and common agreement. All project safeguards agreements specify that safeguard modifications can only be subsequently applied after a common acceptance and not through unilateral action by the state or the IAEA. Another important safeguards consideration concerns confidentiality. Under Article VII (F) of the IAEA statute, the director-general and the staff cannot disclose any confidential information other than to the board of governors who supervise their work. Furthermore, under Article XII dealing with agency safeguards any report on safeguards noncompliance must be reported to the director-general who can only transmit such a report to the board of governors for further negotiation and action. One of director-general Eklund's last official actions was in July 1981 to dismiss an agency safeguards inspector, Mr. Richter, for disclosing confidential safeguards information in this case to a U.S. senator.

One of Mr. Blix's first acts on becoming director-general was to give an interview in February 82 to the **New York Times** in which he stated that while the agency had no evidence of Pakistani diversion, the existing safeguards were not adequate and that amongst other countries India and Pakistan were refusing to submit to agency inspection various unsafeguarded facilities.

The Indian government immediately delivered to the director-general an aide memoire in protest and received in reply an apology. Pakistan's reaction is not on record and it became the target of a public effort by the IAEA to impose additional safeguards utilising a hitherto new safeguards concept that the scope and level of assurance are main factors in the resulting safeguards effectiveness. While the agency could find no evidence of non-compliance after 70 inspections, it pressed this issue, with the director-general again indicting Pakistan during a press conference, while visiting India in December 82. As for India, the IAEA agreed partially to safeguard the new Tarapur reprocessing plant for safeguarded fuel and did not complicate the new Indo-French accord for fuel supplies for the Tarapur reactor now that the U.S. had backed out as a supplier.

By February, 1983, Pakistan was forced to accept a heightened safeguards regime for KANUPP in a gesture of unilateral submission unprecedented in the history of international nuclear energy exchanges. We should have formulated our policy response at the very beginning of this episode, either to stand pat on our secure legal position or we should have decided to accept these new conditions on an already safeguarded facility. By temporising, we only increased the suspicions of the international community which was needless because even a hypothetical diversion capability would have had to remain covert and, therefore would have lacked credibility.

We must realise that international assessments regarding our capabilities rest on a number of our admissions and external suppositions. There is KANUPP and a small insignificant research reactor at PINSTECH. We admit having a research enrichment facility and therefore by implication, a uranium hexafluoride gas production plant, a fuel fabrication facility. Since 1979, there seems to have been an international suspicion, if not consensus, that we have built or are building a small hot cell reprocessing laboratory near PINSTECH. This was specifically mentioned in the international safeguards study of September 1979 prepared by the international consultative group on nuclear energy which had a Pakistani participant who expressed dissenting views in general, in Theodor Winkler's paper of April 1980 on nuclear proliferation and the third world,

and in Shai Feldman's tendentious article in the journal, **Survival**, May/June 1981.

Where do we go from here? We must begin by clearly identifying the various nuclear options open to us, how to make them credible to our friends and potential adversaries and the lead time frames involved before choosing the best option or mix of options.

In scenario one, our capability time frame can be assessed by the time it would take us to terminate the Canadian agreement, dependent IAEA safeguards, subsequent short fuel burn up, cooling time and reprocessing. Time: eighteen months for an unsafeguarded capability as fuel already produced would still be covered by pursuit safeguards.

In scenario two, we achieve high weapons grade uranium enrichment by developing our nascent centrifuge effort. The problem would then be to achieve credibility as no international observer would rely on our unsubstantiated declaration to this effect and a demonstration explosion may not be in our interest. In this case we could achieve recognition for this capability by presenting a strategic quantity of high enriched uranium 235, ten kg., to the IAEA which is empowered under Article IX to accept such special fissionable materials for deposit and for delivery to other members for research purposes.

In scenario three, we finally decide to build our own small unsafeguarded research reactor or even a crude burn pit pile from which we could extract uranium for reprocessing. The cost, depending on the sophistication, would be between ten to fifty million dollars. The time frame, two years from commencement to plutonium production. This is really the preferred option, especially if the more complicated enrichment route proves intractible.

As all these three options might take some time to mature, we must find a modality which can be superimposed not only on our existing safeguard obligations but should also cover existing safeguarded and unsafeguarded facilities in the quickest possible time to shore up our deteriorating security position within the overall context of a flexible international constitutional progress. We should, therefore, immediately declare to the IAEA that we intend to reprocess, under safeguards, nuclear fuel irridated at KANUPP. In that eventuality, as in the case of India at Tarapur, IAEA safeguards would apply to any existing reprocessing facility that we might have, only as long as the safeguarded fuel is being processed therein. Safeguards would also apply to the plutonium thus produced and the storage area as the IAEA is ensuring in India, at Eurochemic-Mol in Belgium, at WAX and KEWA in West Germany, at EUREX and ITREC in Italy, at the Boris Kidric institute in Yugoslavia and at Tokai Mura in Japan.

With plutonium available we could proceed with the development of a zero power research reactor and then, in collaboration, a small experimental breeder reactor. This option could be immediately implemented and would give us a safeguarded but credible last resort capability within a few months. It would then be clear that if we faced a supreme national emergency we have the nuclear wherewithal to meet such a challenge. A recognition of this state of affairs would provide sufficient deterrence. Above all we must come to some decision.

CSO: 5100/7068

SECOND KALPAKKAM UNIT COMMISSIONING TO BE DELAYED

Bombay THE TIMES OF INDIA in English 18 Mar 84 p 5

[Text]

MADRAS, March 17 (UNI).

THE commissioning of the second 235 MW unit of the Madras Atomic Power Station at Kalpakkam, near here, is nearly six months behind schedule due to delay in procurement of machinery.

Station project director, M. H. P. Rao, addressing a news conference at the plant today, said the second unit which was expected to be commissioned by the end of 1984 would attain criticality only by the middle of 1985, according to current indications.

Mr. Rao said the first unit of the station, which was generating 200 MW at present would step it up gradually and reach optimum generation of 235 MW by the second week of April. The licensed capacity of the first unit was 205 units. Any increase in generation would require the clearance of the nuclear safety review committee of the Department of Atomic Energy, (DAE) he said.

He said negotiations with the Tamil Nadu Electricity Board on power pricing were on for the last couple of months. The rate would be finalised soon and was likely to range between 45 and 50 paise per unit.

At present, the board was paying an interim price of nearly 40 paise which would later be adjusted against the negotiated price.

Mr. Rao said the department had acquired expertise to increase capacity of the boilers, and future 235 MW units would be run with four boilers and four pumps instead of eight each as at present.

The first unit had supplied 459 million units of power so far to the Tamil Nadu Electricity Board. The agreement was that the MAPS would supply 700 million units by June this year. Mr. Rao said the target would be achieved much ahead of schedule.

Mr. Rao said the DAE had arranged a meeting with representatives of the industry from all parts of the country at Kalpakkam two days ago to discuss the requirements of nuclear power plants coming up in the country.

Mr. Rao said the heavy water for the first unit was being provided by DAE's plants at Tuticorin and Baroda. The present requirement of heavy water was around 20 kilograms a day. As much as 235 tonnes of heavy water would be required for commissioning the second unit.

The cost of production of heavy water had gone up considerably over the years and was around Rs. 4,000 per kilogram at present, he said.

The cost of the first unit was estimated at Rs. 111.8 crores and that of the second unit Rs. 127 crores.

CSO: 5100/7067

INDIA THREATENS TO WITHDRAW FROM IAEA

Calcutta THE TELEGRAPH in English 20 Mar 84 p 4

[Text]

New Delhi, March 19 (PTI): India has conveyed to the member-countries of the board of governors of the International Atomic Energy Agency (IAEA) that it would withdraw from the agency should its position be jeopardised in any manner on China's entry.

India, along with eight others, has long been "designated," under Article VI of the IAEA statute, as a nation "most advanced in the technology of atomic energy," and by virtue of this status, has been a permanent member of the board.

China joined the IAEA in January and the issue of its seating on the board must be settled by June this year when the board of governors meet to recommend a solution for the general conference.

China sent its application for membership last September only after securing a firm undertaking by the IAEA director-general, Dr Hans Blix, that China would be accommodated.

The complexities of international nuclear politics have a lot to do with difficult situation the IAEA is facing at present. Interested quarters are inaccurately presenting the whole question as a matter for negotiation and settlement between India and China.

Besides India, the other permanent members of the board are the US, Soviet Union, UK, France, West Germany, Canada, Japan and Belgium. Argentina, Australia and Egypt are also permanent board members by virtue of their being the "most advanced" countries from regions that are not represented in the general designation.

CSO: 5100/7070

ALLEGED 'INTERNATIONAL' HOSTILITY TOWARD CHASHMA CRITICIZED

Karachi DAWN in English 12 Apr 84 p 7

[Editorial: "Aid for Chashma Project"]

[Text] Few things are as likely to put most western nations into a fit of hysterics as the issue of Pakistan acquiring nuclear capability — regardless of how often and how convincingly the peaceful purpose of the country's nuclear programme is brought home to these nations and whoever else might be interested to know and understand. Pakistan has been the butt of criticism, and worse, on this count for many years and even now, when it is becoming obvious even to the most obdurate that the idea of developing nuclear weapons is not part of the country's plans, there is a marked hostility towards the peaceful nuclear programme.

In this context, it is interesting to note that Pakistan is to ask for forty million dollars for the Chashma project at the consortium meeting in Paris. It is even more interesting to note that "official circles" think the request may well be refused. It will be known in a day or two how members of the consortium receive the request for aid for this nuclear power plant project, but in case it is refused, it will be a mistake. The phobia which has developed about Pakistan's efforts to develop nuclear energy is irrational and if it is carried to the extent that even efforts in obviously peaceful fields are blocked, then it will be a discrimination which should quite rightly be circumvented in other ways.

Anyone who is even superficially aware of Pakistan's energy needs and its resources should have no difficulty in gauging the problems which the country is facing. Able to meet only about ten per cent of its oil requirements through local production, and with restructed supplied of other conventional energy resources, Pakistan has to depend heavily on oil imports to keep going. The result is not only a severe strain on resources but also a strangulation of development, as is being caused by the current energy crisis.

Apart from these facts, which so amply underscore the country's need to develop its nuclear potential to augment its energy supplies, there is also the argument that a country cannot be discriminated against in the manner that Pakistan is being. It has an unquestionable right of access to nuclear energy, and if Western nations persist in denying it this right, then it should look elsewhere for aid. As a matter of fact, Finance Minister Ghulam Ishaq has said after last year's visit to the USSR that that country is studying the Chashma nuclear project with a view to participating in it. If other avenues are closed to Pakistan, then this option, should it become available, must be taken up and examined.

Pakistan's need for nuclear energy was also endorsed by the director-general of the International Atomic Energy Agency [IAEA]. During a recent visit to the country, he stated clearly that Pakistan has sufficient organisational capacity and technological expertise to undertake major projects in the area of peaceful use of nuclear energy. Apart from the fact that the IAEA has so far not had cause to regard Pakistan's nuclear projects with any suspicion from the safety angle, its director-general stressed this aspect during his visit and said that he was convinced Pakistan's safeguards and trained manpower are sufficient to warrant further development of use of nuclear energy.

With a certification of this sort it is difficult to see why some Western countries should have any doubts about Pakistan's ability to manage nuclear installations safely. The weapons aspect has also been convincingly answered by Pakistan, although it should be obvious that with the kind of equipment it has, and its willingness to accept safeguards suggested by the IAEA, the development of nuclear weaponry is an impossibility. Under the circumstances Pakistan will be justified in seeking assistance from wherever it is available — of course, on terms that are acceptable — should it be refused the aid that it is seeking currently.

CSO: 5100/4713

SOUTH KOREA OFFERS HELP FOR CHASHMA PLANT

Karachi JANG in Urdu 18 Apr 84

[Text] Islamabad, April 18 KYODO — South Korean constructors are ready to help build a controversial 900 megawatt nuclear power plant in Pakistan, the Urdu newspaper *"JANG"* has said. the paper, in a story on a South Korean investment mission now in Pakistan, said the head of a major South Korean power plant builder has offered help in building the plant which has been boycotted by all major Western nuclear contractors.

The proposed plant, to be built at Chashma about 160 kilometers north of Islamabad, has been boycotted because Pakistan refused to accept international checks on the plant and has not signed the nuclear non-proliferation pact, but the South Korean businessman said his company would be willing to undertake construction.

South Korea is not a member of the Vienna-based International Atomic Energy Agency.

Bids on the Chashma plant were called several moths ago, but Western companies, including Japan's Hitachi and Toshiba, did not enter tenders and Pakistan turned to the Soviet Union for help. The Soviets, however, call for safeguards in plants they help build and appear unlikely at the moment to help Pakistan unless its stand on plant checks is changed.

CSO: 5100/4713

MUNIR AHMAD KHAN'S TERM OF OFFICE EXTENDED

Islamabad THE MUSLIM in English 20 Mar 84 p 1

[Text] Islamabad, March 19--President Ziaul Haq has reappointed Munir Ahmad Khan as Chairman, Pakistan Atomic Energy Commission, for a further period of three years. He has been heading the commission since 1972, it was officially stated.

Prior to his appointment as Chairman, Pakistan Atomic Energy Commission, he had served the International Atomic Energy Agency for 14 years and headed nuclear reactor engineering activities of the agency. He participated the 'Atom for peace' programme in 1956 and worked at the Argone National Laboratories in the USA. He was a Scientific Secretary of the Geneva Conferences on peaceful uses of atomic energy held in 1964 and 1971.

The peaceful programme of the Pakistan Atomic Energy Commission has grown remarkably in the last decade with the completion of several new institutes and establishments dealing with nuclear power, fuel cycle including uranium refining and processing, application of nuclear techniques in agriculture, medicine and industry and training of manpower. The high quality of research and development work done in these establishments has placed Pakistan among the leading countries of the developing world in the nuclear field.

Munir Ahmad Khan has served as a member of the Board of Governors of IAEA for several years. He is a leading spokesman for the third world for the sharing and transfer of peaceful nuclear technology for economic and technical development.--APP

CSO: 5100/4712

PAKISTAN TO TRAIN NIGER NUCLEAR SCIENTISTS

Karachi BUSINESS RECORDER in English 29 Mar 84 p 7

[Text]

LAHORE, March 28: Niger will send its scientists to Pakistan for training to run a radio-isotopes centre set-up in that country.

This was stated by Niger's Minister for Higher Education and Scientific Research, Illa Maikassoua, while talking to reporters at the Lahore Airport on his arrival here from New Delhi for a week's visit to Pkaistan.

Niger, he said, believed in peaceful use of nuclear technology and that the radio isotope centre had been set-up for the same purpose.

Niger also wants tfaining of its teaching staff to man Niger's universities, he added.

Ansereing a question, he said there was a vast score of collaboration between Pakistan and his country in different fields, specially agronomy.

His country was aware of Pakistan's research programmes in the field.

Illah Maikassoua said the two countries could also cooperate in industry.

During his visit he would see the management of Islamic universities as Niger had also set-up some Islamic institutions.

The Niger Minister hoped that his visit would reinforce the already existing cultural relations between the two Islamic countries.

Earlier, the Federal Education Minister, Dr. Muhammad Afzal, Provincial Secretary Education and Chairman, Board of Intermediate and Secondary Education received him.–PPI.

CSO: 5100/4712

BRIEFS

ROESSING CONTRACT TERMINATED--The British Civil Uranium Procurement Organisation has announced that it was terminating its contract for supplies of uranium ore from Rossing at the end of this year. It intends to obtain further supplies from other sources such as Canada and Australie thereafter. It was also announced that it was intended to cut the uranium stockpile in the United Kingdom by half over the next six years. This decision, however, does not effect the Rossing operation as it has a number of contracts to supply various purchasers whose identity cannot be disclosed in terms of the Nuclear Energy Act. In the meanwhile the author of the banned book The Rossing File, Mr. Richard Roberts was arrested under security laws in Swakopmund earlier this week and taken to Windhoek. Mr. Roberts works for the Campaign Against Namigian Uranium Contract and recently undertook a visitor's trip on a Thursday to the Rossing mine. [Text] [Walvis Bay NAMIB TIMES in English 3 Mar 84 p 1]

URANIUM PROSPECTS 'NOT GOOD'--PROSPECTS on the world uranium market looked extremely gloomy for at least the next five years, a Director of the Manpower and Management Foundation of southern Africa, Mr Denis Etheridge, said in Windhoek. According to SWABC News report last Friday, he attributed the unfavourable situation for uranium to the considerable power conservation measures introduced after the world energy crisis, severe economic recession and environmental opposition to nuclear fuel. Mr Etheridge said the starting of the new high grade uranium mines in Canada and Australia would place countries with low grade mines, of which Namibia is one, at a considerable cost disadvantage. [Text] [Windhoek THE WINDHOEK ADVERTISER in English 27 Mar 84 p 4]

CSO: 5100/31

BRIEFS

SWEDEN HALTS PLUTONIUM SALE TO BELGIUM--Until further notice, the government will not permit the sale of 3.3 kg plutonium from Studsvik to a company in Belgium. The government is closely examining various methods of handling plutonium from Swedish reactors. Safety, international control, and other factors are being weighed. No plutonium will be sold to other countries as long as these studies are underway. [Text] [Stockholm DAGENS NYHETER in Swedish 24 Mar 84 p 6] 9336

CSO: 5100/2556

CONTROVERSY SURROUNDING 'SECURE' NUCLEAR REACTOR CONTINUES

Stockholm DAGENS NYHETER in Swedish 24 Mar 84 p 35

[Article by Roland Gyllander]

[Text] Despite the nationwide referendum and a parliamentary resolution to phase out nuclear power in Sweden, new types of reactors are still being developed. The name "Secure" has appeared in the debate over the future of heating in our cities and towns. Many believe that this is a particularly evil beast, while others believe it will save us from acid rain and coal dependence.

Secure is the abbreviation for the carefully chosen name Safe and Environmentally Clean Urban Reactor. This is a new type of nuclear reactor from Asea Atom.

During an emergency, it would shut itself down automatically, without pumps or valves. This is achieved by placing the reactor core in a kind of open pipe which, in turn, is in a large pool of cold water.

External measures are used to balance the pressure and temperature of the water within the reactor itself. This permits the reactor to operate. If something goes wrong, however, natural laws take over and the reactor core is flooded with boron-containing water from the surrounding pool.

The element boron has the ability to absorb neutrons. In this way, the fission process caused by the neutrons in the reactor core stops. The reactor is then shut down and cooled.

The Secure HL nuclear heating plant is conceived as an underground facility for district heating in cities and towns.

It is "driven" by a core of uranium-filled fuel rods, just like an ordinary nuclear reactor, but it produces no high-pressure steam for turbines. Instead, it produces hot water (120 degrees) for a district heating network, by way of an external heat exchanger.

The reactor core sits in a kind of pipe that is totally immersed in a large concrete tank--the pool. At the top, the pipe is shaped like a so-called gas

lock and is filled with nitrogen gas (see figure).

Pumped Out

Normally, the water in the pool would immediately flow up through the pipe and force the gas out of the gas lock and up to the top of the pool.

During operation, however, the pool water cannot enter the core from below because feed water is being pumped in to be heated. This water is pumped out at the same rate from above after passing by the fuel rods in the core and being heated.

Thus, there is a certain overpressure below the core which keeps the pool water out. Above the core, there is a certain negative pressure that holds the gas in the gas lock. If the pump should stop, the pressure difference would disappear and the pool water would flow up into the core.

The pressure in the device is 0.7 MPa (megapascal). This is seven times higher than normal atmospheric pressure at the earth's surface. For this reason, the water does not boil even though it is 120 degrees hot.

The pipe through which the water is pumped out at the top of the core contains a narrowing. The flow rate of the water is greatest and its pressure lowest at this narrowest part of the pipe.

If the core produces too much heat, causing the water temperature to rise, the water will start to boil at this narrowing before boiling anywhere else.

Decay Power

Since the steam bubbles take up more space than the water, the suction at the core side of the narrowing disappears. It then "looks" to the core like the pump has stopped functioning. Thus, the pool water rises and the core shuts down. Tests with models have demonstrated that this principle works.

While the reactor is operating, its power is regulated from the outside by varying the boron content in the feed water. As the boron content decreases, more heat is produced and vice versa.

Even when a nuclear reactor is shut off, however, some heat is generated because of the high radioactivity of the fuel. This so-called decay power requires cooling by an external cooling system. If this system remains damaged for a long period of time, for example during a war situation, the temperature in the pool water will rise. After 2 days it would begin to boil.

If no emergency cooling occurs (which could be accomplished simply by adding more water) the water level in the pool will drop as water boils away, so that eventually the core could become dry by overheating and a meltdown with the release of radiation could occur.

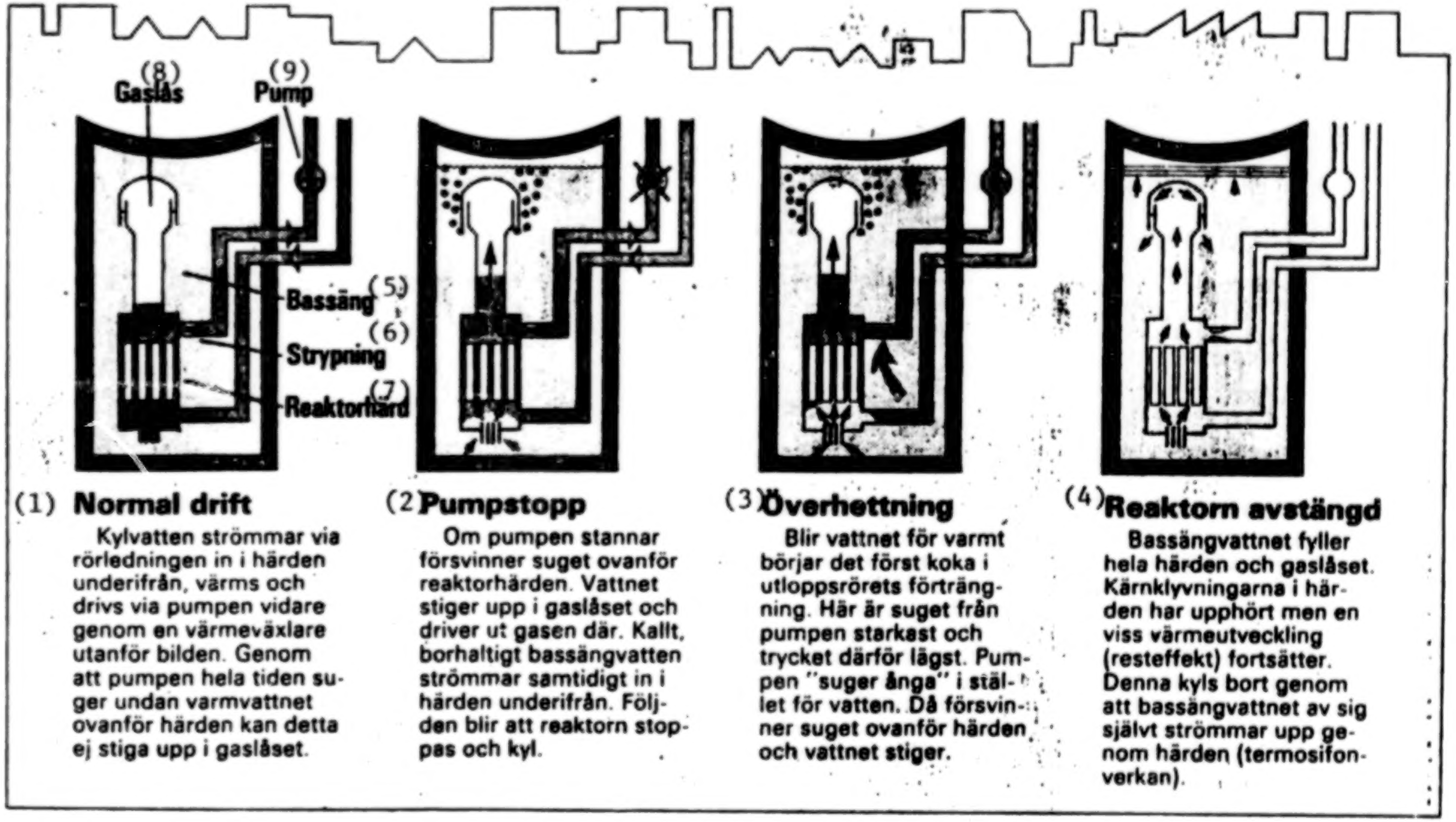
7 Days

The pool is so large that this would require at least 7 days. Thus, the Secure reactor could be left unmonitored for 7 days in an emergency situation. Electricity generating reactors of the type used today must be monitored every 30 minutes.

In addition to the nuclear heating plant, Asea Atom is designing a new generation of power reactors using the same "pool" principle.

The entire pool in these Secure P reactors consists of a large, steel-clad pressure vessel of prestressed concrete, constructed according to a method developed for Asea's Quintus high-pressure press.

The reactor operates like a pressurized water reactor, like most Ringhals reactors, but for safety reasons the steam generator is also immersed in the pool.



Key:

1. Normal operation. Cooling water flows in through a pipe below the core. It is heated and pumped to a heat exchanger, not shown in the picture. Since the pump constantly removes the hot water above the core, the water cannot rise up into the gas lock.
2. Pump Stoppage. If the pump stops, the suction above the reactor core disappears. The water rises into the gas lock and drives out the gas. Cold, boron-containing pool water flows into the core from below at the same time. As a result, the reactor is shut off and cooled.
3. Overheating. If the water becomes too hot, it begins boiling first at the narrowing in the outlet pipe. Here the suction from the pump is greatest and, thus, the pressure is lowest. The pump "draws steam" instead of water. As a result, the suction above the core disappears and the water rises.
4. Reactor shutdown. The pool water fills the entire core and the gas lock. The fission process in the core has stopped, but some heat (decay power) is still generated. This heat is removed because the pool water flows up through the core on its own (thermosiphon effect).

5. Pool 6. Narrowing 7. Reactor core 8. Gas lock 9. Pump

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